UTILITY

PATENT APPLICATION TRANSMITTAL

(Only for new nonprovisional applications under 37 CFR 1.53(b))

Attorney Docket No	690-009312-US(PAR) D/99836	Total Pages:	19

First Named Inventor or Application Identifier

Kamran Uz Zaman

Express Mail Label No.:

APPLICATION ELEMENTS

See MPEP Chapter 600 concerning utility patent application contents.

ADDRESS TO: **Assistant Commissioner for Patents**
Box Patent Application
Washington, DC 20231

1. ☒ Fee Transmittal Form
(Submit an original, and a duplicate for fee processing)

2 ☒ Specification (incl. claims) (Total Pages: 13)

3. X Drawing(s) (35 USC 113) (Total Sheets: 6)

☐ Informal ☐ Formal

4. X Oath or Declaration (Total Pages: 2)

a X Newly executed (original or copy) ☐ Unexecuted-

b. ☐ Copy from a prior application (37 CFR 1.63(d))
(for continuation/divisional with Box 17 completed)
[Note Box 5 below]

☐ i. DELETION OF INVENTOR(S)
Signed statement attached deleting Inventor(s) named in the prior application, see 37 CFR 1.63(d)(2) and 1.33(b).

5 ☐ Incorporation By Reference
(usable if Box 4b is checked)
The entire disclosure of the prior application, from which a copy of the oath or declaration is supplied under Box 4b, is considered as being part of the disclosure of the accompanying application and is hereby incorporated by reference therein.

6. ☐ Microfiche Computer Program (Appendix)

7. Nucleotide and/or Amino Acid Sequence Submission
(If applicable, all necessary)

a. ☐ Computer Readable Copy
b. ☐ Paper Copy (Identical to computer copy)
c. ☐ Statement verifying identity of above copies

ACCOMPANYING APPLICATION PARTS

8. X Assignment Papers (cover sheet & document(s))

9. X 37 CFR 3.73(b) Statement (when there is an assignee) X Power of Attorney

10. ☐ English Translation Document (if applicable)

11. Information Disclosure Statement (IDS)/PTO-1449 Copies of IDS Citations

12. ☐ Preliminary Amendment

13. ☒ Return Receipt Postcard (MPEP 503)
(Should be specifically itemized)

14. ☐ Small Entity Statement(s) ☐ Statement filed in prior application, Status still proper and desired

15. ☐ Certified Copy of Priority Document(s)
(If foreign priority is claimed)

16. ☐ Other:

17. ☐ If a **CONTINUING APPLICATION**, *check appropriate box and supply the requisite information:*
☐ Continuation ☐ Divisional ☐ Continuation-in-part (CIP) of prior application No: /

18. **CORRESPONDENCE ADDRESS**

☐ *Same as prior application* ☒ *Correspondence address below*

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Attorney Docket No. D99836

690-009312-US(PAR)

19. ☐ Cancel in this application original claims: of the prior application before calculating the filing fee. (At least one original independent claim is retained for this filing).

20. ☒ The filing fee is calculated below:

CLAIMS AS FILED, LESS ANY CLAIMS CANCELED BY ABOVE-INDICATED AMENDMENT(S)				
(1) FOR	(2) NUMBER FILED	(3) NUMBER EXTRA	(4) RATE	(5) CALCULATIONS
TOTAL CLAIMS (37 CFR 1.16(c))	**0** 23 - 20 =	**3**	x $ 18	= **$54.00**
INDEPENDENT CLAIMS (37 CFR 1.16(b))	**0** 3 - 3 =	**0**	x $ 78	= **$0.00**
MULTIPLE DEPENDENT CLAIMS (IF APPLICABLE) (37 CFR 1.16(d))		ANY - - **0**	$ 260	= **$ 0.00**
BASIC FEE (37 CFR 1.16(a))				690.00
TOTAL =				**$ 744.00**

21. ☒ The Commissioner is hereby authorized to charge any filing or prosecution fees which may be required, under 37 CFR 1.16, 1.17, and 1.21 (but not 1.18), or to credit any overpayment, to Account No. 24-0037. An additional copy of this form is enclosed.

22. ☒ This is an authorization under 37 CFR 1.136(a)(3) to treat any concurrent or future reply, requiring a petition for extension of time, as incorporating a petition for the appropriate extension of time.

23. ☐ Amend the specification by inserting before the first line the sentence:
--This application is a ☐ continuation ☐ continuation-in-part ☐ divisional of Application(s) No(s). , filed .--

24. ☐ A CIP declaration is enclosed.

25. X Power of Attorney

a. X The power of attorney appears in the original papers of the enclosed prior application.
b. ☐ Enclosed is a copy of the declaration and power of attorney from the enclosed prior application.
c. ☐ A new declaration with power of attorney is enclosed.

UTILITY PATENT APPLICATION TRANSMITTAL - 37 CFR 1.53(b)

(Executed Attachment to Page 1)

Attorney Docket No.: **690-009312-US(PAR) D/99836**

26. ☐ The following inventors named in the prior application are deleted per 37 CFR 1.53(b)(1), 1.63(d)(2) and 1.33 (b):

27. ☐ This application is adding one or more inventors under 37 CFR 1.48 to a previously executed application, with an enclosed: petition, fee, newly executed declaration from all inventors, and written consent of the assignee.

28. ☐ This application claims the priority benefit of one or more Provisional Application No(s). and the first sentence of this application has been or will be amended to so indicate.

29. ☐ Priority is claimed from
(reinsert all previous priority claims for the entire chain of any prior applications).

30. ☐ Other paper(s) enclosed:

Respectfully submitted,

Clarence A. Green
Signature per 37 CFR 1.33 & 34
Date: 7/28/00
Registration No. 24,622
Telephone No. (203)259-1800

690-009312-US(PAR)/D99836

Patent Application Papers Of:

Kamran Uz Zaman

L. John Potter

Stanley J. Pietrzykowski Jr.

For: A System and Method for Optically Sensing Defects in OPC Devices

A System and Method for Optically Sensing Defects in OPC Devices

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to optically sensing manufacturing defects in organic photo conductors (OPC) and, more particularly, to detecting bottom edge wipe in the manufacture of OPCs .

2. Prior Art

Cylindrical aluminum organic photo conductor (OPC) substrates undergo dip-coating process by vertically immersing the cylindrical OPC in a dip tank. After dipping it is required that the trailing edge of the part must meet certain specifications in order to avoid bottom edge wipe defects (i.e., where dip coating residue remains on the bottom of the OPC). Fig. 5 shows that bottom edge wipe (BEW) defects are the most common of defects caused by the dipping process. However, existing automatic visual inspection (AVI) systems are not designed to inspect for BEW defects. The existing AVI systems only inspect for defects within the image area of the OPC and ignores the areas outside the image area, i.e., the bottom edge area. Yet, the interface of the bottom edge area within larger systems and subsystems is critical to the performance of such systems. For this reason, the OPC bottom edge area is subjected to an outgoing quality control, but not until after value is added to the defective OPC at several other stages in the manufacturing process prior to the quality control check. Thus, the failure to detect BEW defects early in the

manufacturing process results in decreased productivity as well as lost value.

SUMMARY OF THE INVENTION

In accordance with one embodiment of the invention, a system for optically sensing manufacturing defects in OPC devices is provided. The system comprising an illumination source for illuminating an OPC device; at least one optical sensor positioned to view the illuminated device; and a controller connectable to the optical sensor, the controller comprising a threshold detector for detecting manufacturing defects.

Another aspect of the invention is a method for optically classifying residues on at least one bottom area of a OPC. The method comprising the steps of: illuminating the at least one bottom area of the OPC; capturing reflected illumination from at least one illuminated bottom area of the OPC device; comparing the captured reflected illumination with at least one threshold level; and classifying at least one bottom area of the OPC device based upon the comparison of the captured reflected illumination with the at least one threshold level.

Another aspect of the invention is a method for optically discriminating an Organic Photo Conductor (OPC) device. The method comprising the steps of illuminating a bottom area of the OPC device; sensing reflected light from the illuminated OPC bottom area; and comparing reflected light with a threshold level to determine if a defect exist.

BRIEF DESCRIPTION OF THE DRAWINGS

The foregoing aspects and other features of the present invention are explained in the following description, taken in connection with the accompanying drawings, wherein:

Fig. 1 is a schematic diagram of one embodiment of the invention;

Fig. 2 is a method flow chart of one embodiment of the invention showing the steps for classifying the bottom area as acceptable, non-acceptable, or quasi-acceptable;

Fig. 3 is a detailed method flow chart corresponding to the method flow chart shown in Fig. 2 of one embodiment of the invention showing the steps for classifying the bottom area as acceptable or non-acceptable;

Fig. 3A is a schematic diagram of a circuit for implementation of the method shown in Fig 3.

Fig. 4 is a detailed method flow chart of one embodiment of the invention corresponding to the method flow chart shown in Fig. 2, showing the steps for classifying the bottom area as acceptable , quasi-acceptable, or non-acceptable; and

Fig. 5 is a graph illustrating the relations between threshold levels and degree of BEW residue;

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to Fig. 1, there is shown an exploded perspective view of a bottom edge wipe (BEW) detection system incorporating features of the present invention. An illumination source 2 illuminates the OPC device 10. At least one optical sensor 4 is positioned to view the illuminated OPC 10. A controller 6 connectable to the optical sensor senses manufacturing defects in the OPC device 10. In addition, the controller 6 is connectable to a database 8 containing threshold information for classifying the OPC 10 under test. The controller is also connectable to a monitoring device 9 such as an audible alarm or visual display capable of alerting a user when a defect occurs. Although the present invention will be described with reference to the embodiments shown in the drawings, it should be understood that the present invention can be embodied in many alternate forms of embodiments.

Referring now to Figs. 2 and 5; in Fig. 2 there is shown a method flow chart of one embodiment of the invention showing the steps for classifying the bottom area of a OPC as acceptable, non-acceptable, or quasi-acceptable. First, the bottom edge area of the OPC is illuminated 22 with a suitable illuminating device. Some examples of illuminating devices are light emitting diodes (LEDs), LASERs, or an emitter capable of emitting electromagnetic radiation of one or more wavelengths (i.e., a white light source). The reflected illumination from the bottom edge area of the OPC is captured 24, where capturing the reflected illumination may be any suitable method for converting illumination intensity to a reference voltage or digital signal. The captured illumination is compared 26 with a predetermined threshold level to determine 28

if a first threshold level has been exceeded. If the first threshold has not been exceeded the OPC is classified as acceptable 216. If the first threshold has been exceeded the captured illumination is compared 29 with a second threshold level. If the captured illumination exceeds 210 the second threshold level the OPC is classified as non-acceptable 214 otherwise the OPC is classified as quasi-acceptable 212.

Referring now to Fig. 3 and there is shown a detailed method flow chart, corresponding to the method flow chart shown in Fig. 2, of one embodiment of the invention showing the steps for classifying the bottom area as acceptable or non-acceptable; in Fig. 3A there is shown a schematic diagram of one implementation of a circuit for implementing the method shown in Fig 3. First the OPC bottom area is illuminated 32 and reflected illumination is captured 34, and converted 35 to a voltage by a semi-conductor device such as a photodiode 3A2. The converted voltage is compared 36 to a predetermined voltage level after being amplified by an amplifier comprising a feedback resistor 3A4, an input resistor 3A6, and an operational amplifier 3A8. The predetermined voltage level may be set by reference to a known good OPC device with acceptable bottom edge residue. If the converted voltage exceeds 38 the predetermined voltage level as measured by voltmeter 3A10 the OPC device is classified 310, by 3A10 as non-acceptable; otherwise the device is classified as acceptable 312.

Referring now to Fig. 4 there is shown a detailed method flow chart of one embodiment of the invention showing the steps for classifying the bottom area as acceptable, quasi-acceptable, or non-acceptable. First, the bottom

area of the OPC is illuminated 42 and reflected illumination is captured 44 by a charge coupled device (CCD) such as a digital camera. Through well known digital techniques the captured illumination is differentiated 46 into gray level pixel data or matrix cells. Dark areas of the bottom edge portion of the OPC due to BEW residue will correspond to dark pixels while lighter areas of the bottom edge portion will correspond to lighter pixels. A first threshold ratio is predetermined by determining a number of allowable dark pixels to the total number of pixels 48. For example, if a certain band is comprised of five dark pixels and the total number of pixels is fifty, the threshold ratio is one tenth or .1. The measured ratio of the device under test is then compared 49 with the first predefined threshold ratio that may be stored in a data storage area. If the ratio is determined 410 to have not exceeded the first predefined threshold ratio the OPC is classified as acceptable. If the ratio is determined 410 to have exceeded the first predefined ratio then a second comparison to a second predefined ratio is made 411. If the ratio is determined 412 to have exceeded the second predefined ratio the part is classified as non-acceptable; otherwise the part is classified as quasi-acceptable. For determining trends and maintenance requirements the classification of each OPC may be stored in the data storage area.

Thus the invention advantageously increases productivity and improves product quality by early inspection and detection of manufacturing defects early in the manufacturing process. It should be understood that the foregoing description is only illustrative of the

invention. Various alternatives and modifications can be devised by those skilled in the art without departing from the invention. Accordingly, the present invention is intended to embrace all such alternatives, modifications and variances which fall within the scope of the appended claims.

CLAIMS

What is claimed is:

1. A system for optically sensing manufacturing defects in OPC devices, the system comprising:

an illumination source for illuminating the OPC device;

at least one optical sensor positioned to view the illuminated OPC; and

a controller connectable to the optical sensor, the controller comprising a threshold detector for sensing bottom edge wipe (BEW) manufacturing defects in the OPC device.

2. A system as in claim 1 wherein the illumination source comprises a light emitting diode (LED).

3. A system as in claim 1 wherein the illumination source comprises a LASER.

4. A system as in claim 1 wherein the illumination source comprises:

an emitter, wherein the emitter emits electromagnetic radiation of at least one wavelength.

5. A system as in claim 1 wherein the at least one optical sensor comprises a charge coupled device (CCD) camera.

6. A system as in claim 1 wherein the controller is associated with a data storage area, wherein the data

storage area may be used to store predetermined threshold values and classification result;

7. A system as in claim 1 wherein the threshold detector comprises an array of pixels and the controller further comprises a pixel counter for counting.

8. A system as in claim 1 wherein the controller is associated with a monitoring device for alerting a user.

9. A system as in claim 8 wherein the monitoring device further comprises a visual display monitor.

10. A system as in claim 8 wherein the monitoring device further comprises an audio monitor.

11. A method for optically classifying residues on at least one bottom edge area of a OPC, the method comprising the steps of:

illuminating the at least one bottom edge area of the OPC;

capturing reflected illumination from the at least one illuminated bottom edge area of the OPC device;

comparing the captured reflected illumination with at least one threshold level; and

classifying the at least one bottom edge area of the OPC device based upon the comparison of the captured reflected illumination with the at least one threshold level.

12. A method as in claim 11 wherein the step of illuminating the at least one bottom edge area of the OPC device further comprises the step of illuminating the OPC

bottom edge area with electromagnetic radiation of at least one wavelength.

13. A method as in claim 11 wherein the step of capturing reflected illumination from the at least one illuminated bottom edge area of the OPC device further comprises the step of digitizing the captured reflected illumination.

14. A method as in claim 11 wherein the step of capturing reflected illumination from the at least one illuminated bottom edge area of the OPC device further comprises the step of converting the captured reflected illumination to an analog signal.

15. A method as in claim 11 wherein the step of comparing the captured reflected illumination with at least one threshold level further comprises the step of comparing the captured reflected illumination with a predetermined pixel count.

16. A method as in claim 15 wherein the step of comparing the captured reflected illumination with a predetermined pixel count further comprises the step of comparing the captured reflected illumination with a predetermined gray level pixel count.

17. A method as in claim 11 wherein the step of comparing the captured reflected illumination with at least one threshold level further comprises the step of comparing the captured reflected illumination with a predetermined analog voltage level.

18. A method as in claim 11 wherein the step of classifying the at least one bottom edge area of the OPC further comprises the step of classifying the at least

one bottom edge area as acceptable or alternatively as non-acceptable.

19. A method as in claim 11 wherein the step of classifying the at least one bottom edge area of the OPC further comprises the step of classifying the at least one bottom edge area as one of acceptable, non-acceptable, and quasi-acceptable.

20. A method for optically discriminating an Organic Photo Conductor (OPC) device, the method comprising the steps of:

illuminating a bottom edge area of the OPC device;

positioning an optical sensor to view the illuminated OPC bottom edge area; and

providing a controller connectable to the optical sensor, the controller having a threshold discriminator.

21. A method as in claim 20 wherein the step of illuminating the bottom edge area of the OPC device further comprises illuminating the bottom edge area of the OPC device with a visible light source.

22. A method as in claim 20 wherein the step of positioning the optical sensor to view the illuminated OPC bottom edge area further comprises positioning a charge coupled device (CCD) camera.

23. A method as in claim 20 wherein the step of providing the controller connectable to the optical sensor further comprises the steps of:

providing a gray level band discriminator;

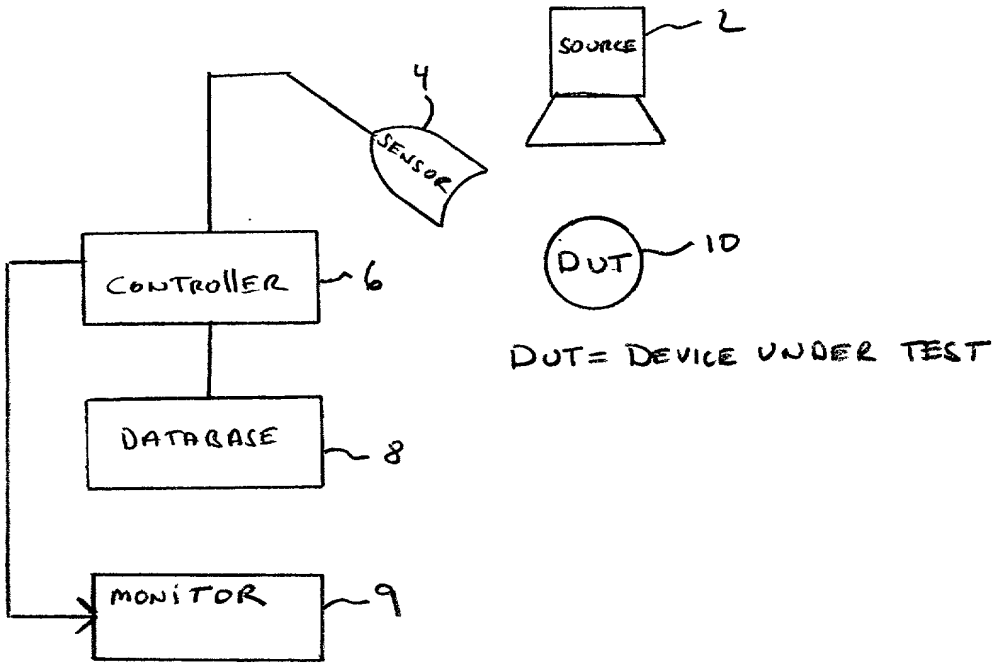
comparing the ratio of a number of pixels within a predetermined gray level band to the total number of gray level pixels to a predetermined ratio; and

classifying the OPC device as acceptable, non-acceptable, or quasi-acceptable based upon said comparison.

ABSTRACT

A system for optically sensing manufacturing defects in organic photo conductor (OPC) devices. The system comprising an illumination source for illuminating the OPC device; at least one optical sensor positioned to view the illuminated device; and a controller connectable to the optical sensor, the controller comprising a threshold detector for determining manufacturing defects.

FIG. 1



DUT= DEVICE UNDER TEST

Fig. 2

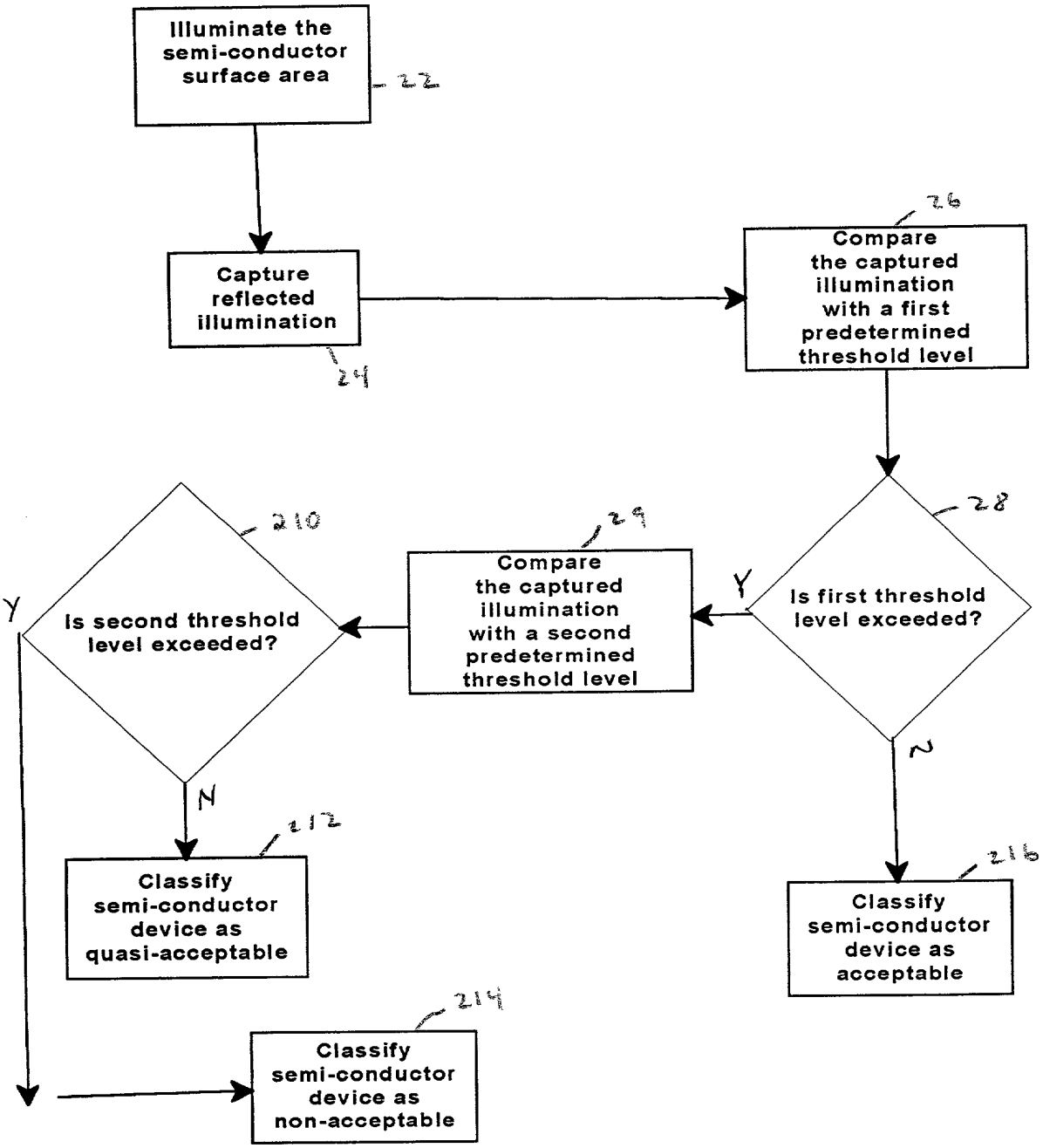

Illuminate the semi-conductor surface area
22
Capture reflected illumination
24
Compare the captured illumination with a first predetermined threshold level
26
Is first threshold level exceeded?
28
Y
N
Compare the captured illumination with a second predetermined threshold level
29
Is second threshold level exceeded?
210
Y
N
Classify semi-conductor device as quasi-acceptable
212
Classify semi-conductor device as acceptable
216
Classify semi-conductor device as non-acceptable
214

Fig. 3

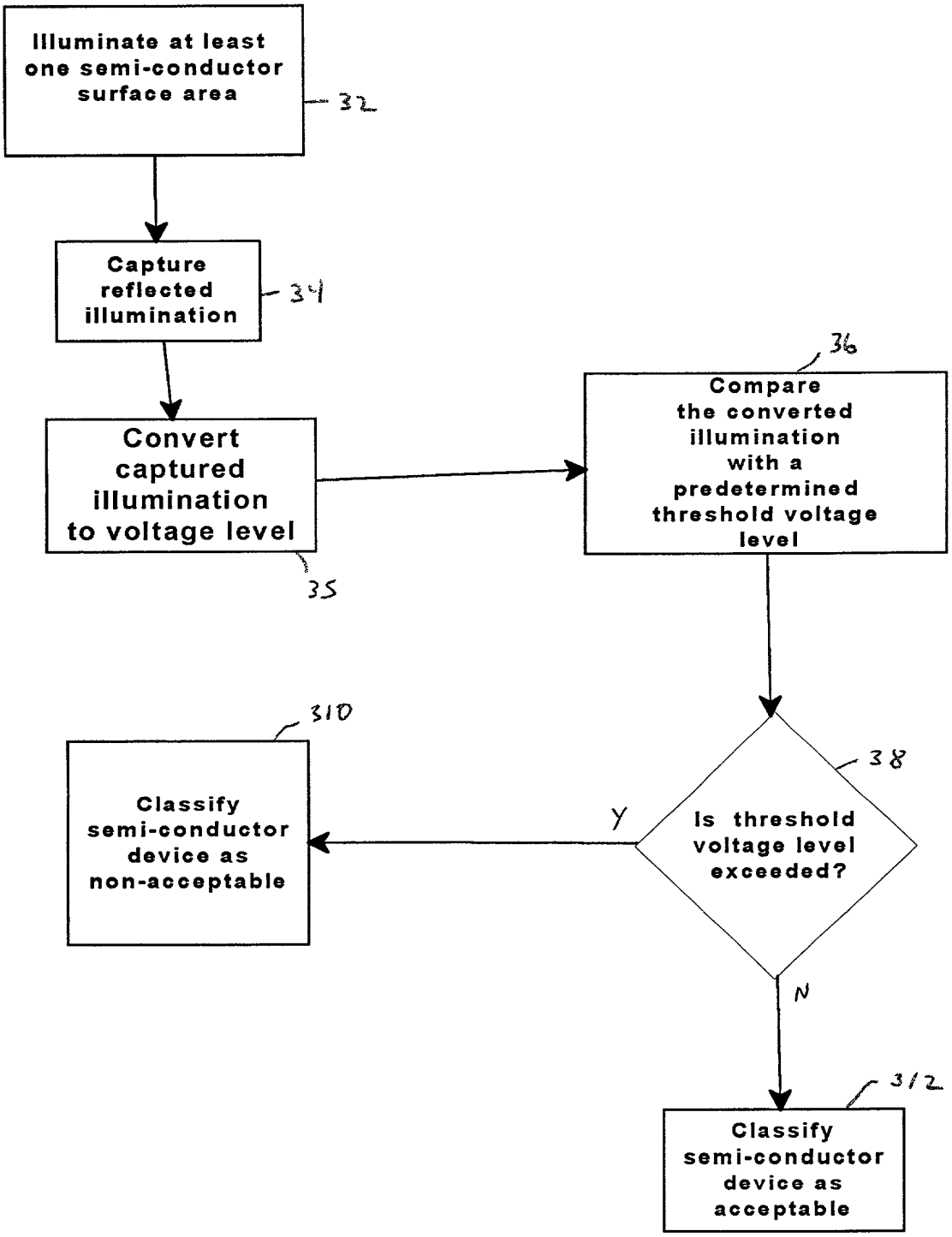

Illuminate at least one semi-conductor surface area
32
Capture reflected illumination
34
Convert captured illumination to voltage level
35
36
Compare the converted illumination with a predetermined threshold voltage level
38
Is threshold voltage level exceeded?
Y
N
310
Classify semi-conductor device as non-acceptable
312
Classify semi-conductor device as acceptable

FIG. 3A

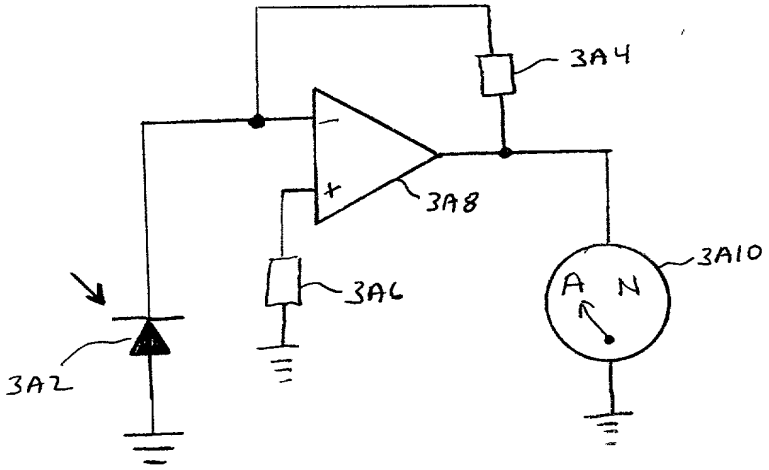


Fig. 4

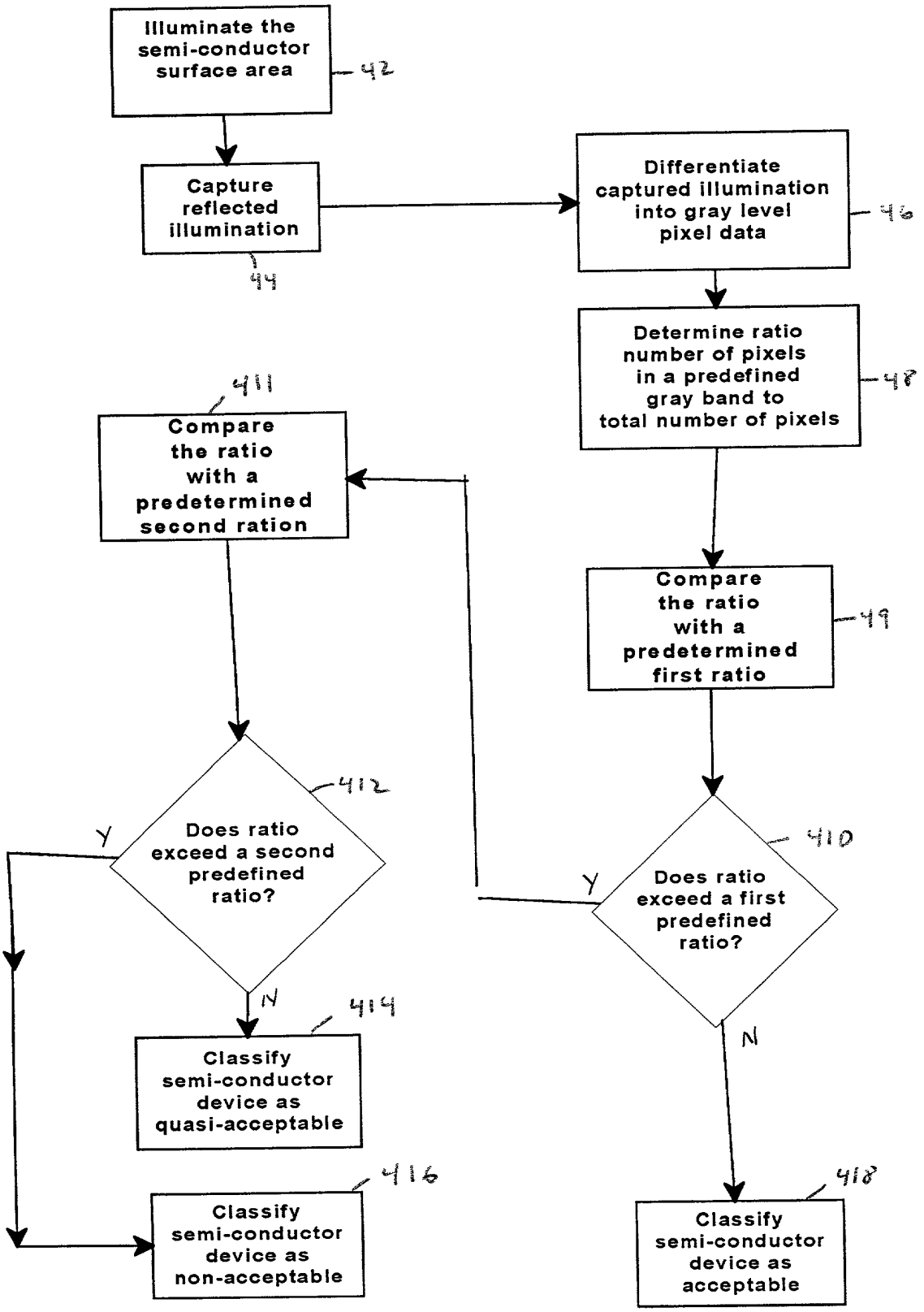
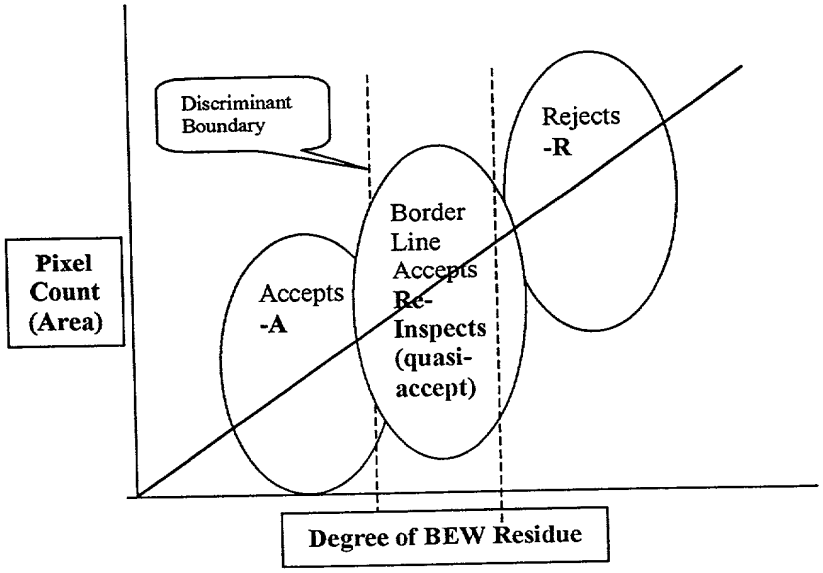

Illuminate the semi-conductor surface area
42
Capture reflected illumination
44
Differentiate captured illumination into gray level pixel data
46
Determine ratio number of pixels in a predefined gray band to total number of pixels
48
Compare the ratio with a predetermined first ratio
49
Does ratio exceed a first predefined ratio?
410
Y
N
Compare the ratio with a predetermined second ration
411
Does ratio exceed a second predefined ratio?
412
Y
N
Classify semi-conductor device as quasi-acceptable
414
Classify semi-conductor device as non-acceptable
416
Classify semi-conductor device as acceptable
418

Fig. 5


Discriminant Boundary
Rejects -R
Border Line Accepts Re-Inspects (quasi-accept)
Accepts -A
Pixel Count (Area)
Degree of BEW Residue

PATENT APPLICATION

Attorney Docket No. D/99836/690-009312-US(PAR)

DECLARATION AND POWER OF ATTORNEY FOR PATENT APPLICATION

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name,

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled: A SYSTEM AND METHOD FOR OPTICALLY SENSING DEFECTS IN OPC DEVICES

the specification and claims of which
☒ are attached hereto OR ☐ was filed on _____ as U.S. Application No. _____

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims.

I acknowledge the duty to disclose information which is material to the patentability as defined in Title 37, Code of Federal Regulations, §1.56.

I hereby claim priority benefits under Title 35, United States Code, §119 of any foreign or U.S. Provisional application(s) for patent listed below, and have also identified below any foreign application(s) or Provisional application(s) for patent having a filing date before that of the application on which priority is claimed:

Prior Foreign or U.S. Provisional Application(s)

(Number)	(Country)	(Day/Month/Year Filed)

POWER OF ATTORNEY: As a named inventor, I hereby appoint the following registered practitioners to prosecute this application and transact all business in the Patent and Trademark Office connected therewith.

John E. Beck	**Reg. No. 22,833;**	**Henry Fleischer**	**Reg. No. 25,582;**
Ronald F. Chapuran	**Reg. No. 26,402;**	**Eugene O. Palazzo**	**Reg. No. 20,881;**
Mark Costello	**Reg. No. 31,342;**	**Denis A. Robitaille**	**Reg. No. 34,098;**
Richard B. Domingo	**Reg. No. 36,784;**	**Clarence A. Green**	**Reg. No. 24,622**
		Mark F. Harrington	**Reg. No. 31,686**
			Reg. No.

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I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under §1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

DECLARATION AND POWER OF ATTORNEY, continued

Name of sole or first inventor: Kamran Uz Zaman

Inventor's Signature: Kamran Uz Zaman Date: 7/26/00
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Citizenship: USA

Post Office Address:
(Same as above)

Name of second joint inventor: L. John Potter

Inventor's Signature: L. Potter Date: 7/26/00
Residence: 64 Delemere Blvd., Fairport, NY 14450
Citizenship: USA

Post Office Address:
(Same as above)

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Inventor's Signature: Stanley J Pietrzykowski Date: 7/26/00
Residence: 132 South Landing Road, Rochester, NY 14610
Citizenship: USA

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(Same as above)